Better Mushrooms, Hops, Tabasco, and Even Mink

By Glen W. Goss

Mushrooms, once an infrequent delicacy in our diet, are now enjoyed regularly. Consumption in this country has tripled since World War II—from a half pound to a pound-and-a-half per person each year.

Research at State Agricultural Experiment Stations plays a major role in perfecting the production, processing, and marketing of commodities of local importance. The mushroom story is one of many examples of significant research efforts in helping agriculture provide us with some of our more unusual products.

Pennsylvania produces nearly 60 percent of the U.S. mushroom crop. Thus, it is only natural that Pennsylvania State University scientists have been working with mushroom growers for a half century.

In 1925, C. A. Thomas started 35 years of dedication as an entomologist developing pest control programs. The first research facility, a mushroom test house, was completed in 1928 with funding support from the Mushroom Growers Cooperative Association. Joint efforts in the industry and cooperation with scientists in the U. S. Department of Agriculture (USDA) and at other land-grant universities followed as Penn State became a focal point of mushroom research and education.

Today, mushroom growers in Pennsylvania employ close to 10,000 people and the cash value of their product in 1974 was $63.8 million. As in any industry, mushroom growers have faced a series of crises.

In the 1960's, cheap-labor imports from Formosa brought concentrated efforts in sharpening production methods and in developing markets.

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In the 1970's a scare, brought about by a precautionary Food and Drug Administration recall, was a temporary threat to the canned mushroom market. Research came to the rescue in responding to calls for aid from the individual mushroom growers and American Mushroom Institute.

New and safer mushroom products now are on the market in competition with foreign imports. Consumers are offered a wide variety of mushroom taste treats as growers meet the challenge.

Development of grain spawn free from pests and disease by James W. Sinden in the early 1930's brought significant changes to the industry. Stressing mushroom development in relation to nutrition beds, Sinden was advised not to work on spawn "as all problems in the field were settled, the process is known in its entirety, and no further improvement could be made." But, seeking a more dependable medium to use in his tests, he went ahead.

"One of the first new mediums tested was grain, specifically wheat, which was placed in flasks with a small amount of water and sterilized. On introduction of the mushroom mycelium (small hair-like roots), I found that it grew very vigorously in a manner different than anything I had previously seen."

Further tests were convincing, and several patents were obtained on the Sinden Grain Spawn Method in 1932 and 1933. Since then, the university's spawn laboratory has been responsible for 60 to 70 percent of the basic culture in the Nation and has been a significant factor in strain selection.

Average commercial yield in pounds per square foot of bed planted has increased from 1.5 in the late 1940's to 2.65 in the early 1970's.

This increased efficiency can be largely attributed to Penn State's mushroom research and educational programs in forced air ventilation systems, low temperature Phase II composting of the growing medium, vegetable oil nutrient supplementation of the compost, machine spawning (seeding) of the mushroom beds, a pest-management program based on a biological foundation, and development of a new fungicide for control of certain diseases of mushrooms. Another research project has shown that loss due to processing shrinkage can be reduced at least 10 percent.

A Mushroom Test-Demonstration Facility was developed and put into operation at Penn State in 1971. A flow-type design saved both time and labor. An automatic materials handling system, whose components are integrated by environmental control equipment, allows introduction of composting materials as a

growth base at one end and removal of mushrooms and spent compost at the other end.

This labor-saving approach results in 6.5 crops a year instead of 2.5 crops. An annual harvest of 22.7 pounds per square foot compares with a traditional 6.5 pound yield.

This model is showing growers how they can adjust their methods to be more competitive in world markets and provide you with a delightful array of mushroom products that fit in your food budget.

That Good Beer

Hopping is something little girls do when they play hopscotch. But mention the word to a brewmaster, and his mind will instinctively run to another kind of hopping—the process that gives his beverage the distinctive flavor and aroma that makes beer taste like beer.

Washington's Yakima and Moxee valleys provide more than 65 percent of the nation's hops. Some 150 farmers receive about $27 million a year for the crop. The remainder are grown in Oregon, Idaho, and California.

Left unattended, hops flourish like a weed. But, producing the high quality demanded by brewmasters is a difficult proposition. Historically, hop culture was a family skill passed down from father to son. It was under this system that Jacob R. Meeker planted Washington's first commercial hops in 1866 in the Puyallup Valley not far from Seattle.

There the industry flourished for nearly two decades. However, the relatively wet climate unfortunately provided excellent conditions for downy mildew. This fungus drove hop production from Western to Eastern Washington. It also reduced Oregon hop production from a peak of 35,000 acres to only 5,300 acres today.

Diseases, insects and mites, and quality problems caused growers to turn to research scientists at Washington State University's Irrigated Agriculture Research and Extension Center near Prosser. Achievements are many and valuable, but three stand out: control of diseases and other pests through chemical and cultural practices, release of new hop varieties, and development of virus-free planting stocks of new varieties.

Financial help came when the Washington State Hop Commission was organized in 1964. Contributing $11,000 a year

until 1973, the growers voted to increase their assessment for research by 50 percent—a measure of their esteem for the work of the agricultural scientists. Another significant source of industry finance is the $30,000 a year coming from the United States Brewers Association.

These funds greatly increase the effectiveness of research at Prosser supported by State and Federal funds.

The search for better hops began in earnest in Washington in 1956 when Calvin B. Skotland, a WSU plant pathologist, surveyed Yakima Valley hop yards where varieties were suffering from virus diseases and nutritional deficiencies. He selected 41 vines for evaluation. After nine years of work, Skotland released three lines of cluster-type hop roots with improved quality and disease resistance. They quickly became the predominant varieties in Washington.

At the same time Stanley N. Brooks, then a USDA Agricultural Research Service agronomist stationed at Oregon State University in Corvallis, developed a cross with superior characteristics. After 16 years of research and development in Washington and Oregon, a new variety called Cascade was released in 1972. It opened a new horizon for Washington's hop industry.

Cascade, a European-type hop, is preferred by some breweries that rely heavily on imports. About 14 million pounds of hops are imported every year, but Cascade is expected to cut into that market and keep more American dollars at home.

When first released, Cascade was not certified virus-free. But, Skotland had already started research on that problem in 1965. Borrowing a technique developed by WSU tree fruit researchers, Skotland began growing hops in heat chambers. It takes time for viruses to spread to new tissue. So by speeding growth in heat chambers, scientists can produce virus-free tissues which are clipped off and propagated under carefully controlled circumstances which keep the plants disease-free.

In 1972, Skotland released 21,000 virus-free cuttings of Cascade hops from which four growers are producing certified virus-free stock for sale to the industry.

A second new variety, Comet, has been released as a high brewing value hop that should be especially useful for extracting and export markets.

Comet is the result of a cross made by Charles E. Zimmerman, an Agricultural Research Service agronomist then stationed at Oregon State University. Jointly released by ARS,

WSU, and OSU, it is more tolerant to downy mildew crown infection than the cluster varieties presently grown, and is tolerant to ringspot virus found in hops in the Pacific Northwest.

These are only a few highlights of what scientists are doing to help ensure the nation's supply of flavoring for beer, and to help make the Pacific Northwest's economy a vital one.

Tabasco Threatened

Often we are unaware that, because of agricultural pests, we might lose something we enjoy. Spread of TEV (Tabasco etch virus) in the Southern United States in the 1950's threatened survival of tabasco sauce—the tangy, taste-tempting treat. This wilt disease, spread by aphids, was defeated by a 20-year breeding program that developed a resistant tabasco pepper variety.

Louisana experts in the heart of the pepper-growing country where tabasco sauce is produced feared in 1959 that if the spread of TEV could not be halted, the state would have to stop growing the pepper. At this time, W. H. Greenleaf had begun to breed TEV-resistant tabasco peppers in the Agricultural Experiment Station at Auburn, Ala.

Greenleaf Tabasco, named for the pathologist and plant breeder who developed it, is not only TEV resistant—it boasts several other desirable characteristics. The new variety is providing growers with resistance to ripe rot; it produces a more concentrated fruit set, thus increasing harvest efficiency; and it has a darker yellow immature fruit and a darker red mature fruit, as well as stronger pungency.

Two Indian pepper varieties from Peru provided the resistance factor in the painstaking breeding program. Four backcrosses to the original tabasco variety were made. The alternating self generations were screened for etch resistance after each backcross. Also, at the third backcross level, breeding techniques called interline crosses concentrated the genes for other desirable characteristics.

Your opportunity to enjoy tabasco sauce thus was preserved by research. As frequently happens, scientists made no spectacular overnight discovery. Clues indicating they were on the right track provided the encouragement for further improvements so that we can still have the fiery hot pepper seeds to make the vinegar extract that, through processing, becomes tabasco sauce.

Minks and Finks

Michigan State University's fur-animal research project got underway in 1948 with a grant and a gift of mink from the Michigan Fur Breeders Association. In addition many other commercial companies are active supporters of the project (private industry and fur-farming organizations at one time were matching the university's dollar input two to one).

Administered by the MSU poultry science department, the project has involved scientists from zoology, physiology, and veterinary pathology. More than 43 papers were published in the past decade. The present work load of the project includes a number of studies designed to provide answers to everyday problems in the industry.

A marked increase in mortality of newborn mink developed in the mid-1960's, when coho salmon taken from the tributaries of Lake Michigan during the spawning run were fed to mink. MSU workers found substantial levels of polychlorinated biphenyls in the salmon, and proved that these chemicals were causing deaths in the young mink.

Recent studies have sought a practical procedure for artificial insemination of mink. A procedure for collecting semen by electro-ejaculation was developed. In subsequent experiments, techniques for handling and extenders for diluting, holding, and storing mink semen were tested and evaluated.

Many shock-type losses associated with anemia have occurred on mink ranches. Studies at Michigan State University have been established to obtain a clear understanding of the ailment, discover the type of anemia involved, determine the heritability of the condition, identify the factor responsible for the problem, and find a remedy or treatment for the disorder.

In addition, research is being conducted on mercury poisoning from contaminated fish and cereals, blood and cardiovascular parameters, and the influence of vitamin E on reproduction in mink.

Research frequently leads to interesting sidelights, even though in some cases the results are negative.

Because of their vicious nature, mink must be raised in individual cages. Scientists have tried tranquilizers and other methods to calm them, hoping to be able to raise mink in colonies. They have had little success.

Using artificial breeding techniques developed at Michigan State University, Richard Aulerich thought it might be possible

to breed more calmness into mink by selecting for this trait or by crossbreeding with closely related calmer animals.

The ferret was one possibility. This cross was tried. In discussing the project, Aulerich said, "If the offspring has the mink's fine fur and the ferret's disposition we'll call it a 'merret.' If it has the mink's disposition and the ferret's coat, we'll call it a 'fink'!"

Attempted crosses to date have come up with nothing. Aulerich is quite philosophical and says, "We knew that in such a cross we could get the ideal we were looking for, or we could get a new species of animal, or we could get nothing. So we weren't too surprised when we got nothing."

Peanuts and Pyrazines

Work with some specialized commodities, such as peanuts, can have far-reaching effects. At the Oklahoma Experiment Station a new era of understanding food flavors was ushered in when biochemists, while seeking to improve the taste and keeping quality of roasted Spanish peanuts, "rediscovered" the important role of nitrogenous organic compounds called pyrazines.

The role of pyrazines had first been discovered by Staudinger and Reichstein in 1927. The knowledge went almost unnoticed until 1963, when new research was published by M. E. Mason, Oklahoma biochemist. With that publication, "the little hole in the dike" became the flood.

At first only five pyrazines were identified. Currently more than 100 are known in practically every cooked food consumed by humans.

As a result, your taste buds frequently get a new taste because the manufacture and use of pyrazines in flavoring has revolutionized the food industry with flavorings that were not possible ten years ago.

Oklahoma scientists have developed an improved technique for rapid amino acid analysis of peanut varieties. This technique will assist scientists in their around-the-world search for peanuts high in protein and vital amino acids.

Kicking the Maple Bucket

Indians used the "sweet water" that flows from a wound in the sugar maple each spring as a source of sugar. From colonial times through the end of the 19th Century, maple sugar was an important staple in rural New England. After white sugar became cheaper, maple sugar and sirup continued to be widely used as

foods. Today, maple flavor also is found in many food products.

Production in the nine major maple states remains at about one million gallons a year. Vermont usually leads the nation with more than a third of the production.

Since Vermont is almost synonomous with maple, it is only natural that Vermont's Agricultural Experiment Station has been a leader in maple research.

Techniques of harvesting and processing maple sap into sirup changed little until after World War II. Research at the university's Proctor Maple Research Farm demonstrated advantages of continuous flow from tree to gathering tank. Plastic tubing made central gathering possible and eliminated buckets on trees that had to be gathered regularly, frequently through hip-deep snow.

Studies of the basic chemistry and physiology of the sugar maple (*Acer saccharum*) started in Vermont nearly 50 years ago. Cooperative work is conducted with the new U. S. Forest Service facility in Burlington, Vt., USDA's Agricultural Research Service Laboratory near Philadelphia, Pa., and with other State Experiment Stations.

Techniques have been developed to determine sugar content and flow of sap to identify superior trees in a natural stand. Vacuum pumping has increased yields from tubing systems, reducing manpower requirements.

New evaporator designs utilize modern fuels to reduce the time needed to boil away excess water while producing high quality sirup. Evaporator studies are being conducted in conjunction with the Forest Service, a USDA agency.

Modern methods also cause problems. With larger producers using oil to fire their evaporators, the energy crisis brings a new threat. Now research is focused on an automatic wood residue fuel system, intended to help maintain production while lowering costs.

Farmers practicing the art of maple sugarmaking were helped in their battle against long, hard hours and costs as the industry emerged from a "cottage handicraft" business to large-scale, self-sufficient units. Frequently, producers are now vertically integrated from production through processing and marketing to make their tasty product available at reasonable cost.

So if your mouth waters for the tasty sirup of maple on your pancakes and other treats, rest assured that maple sugarmakers and scientists are working together to keep those maple products flowing.